B. P. I.—5. V. P. P.—87.

U. S. DEPARTMENT OF AGRICULTURE.

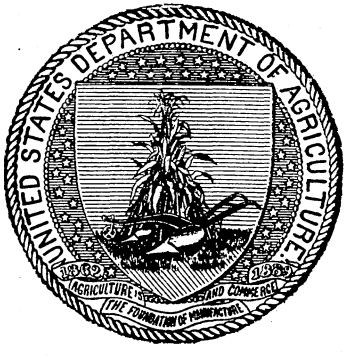
FARMERS' BULLETIN No. 140.

PINEAPPLE GROWING.

BY

PETER H. ROLFS,

PATHOLOGIST, IN CHARGE OF TROPICAL LABORATORY, VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS, BUREAU OF PLANT INDUSTRY.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., August 1, 1901.

SIR: I transmit herewith, and recommend for publication, the manuscript for a Farmers' Bulletin on Pineapple Culture, written by P. H. Rolfs, pathologist in charge of the tropical laboratory of vegetable pathological and physiological investigations of this Bureau.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

PINEAPPLE GROWING.

INTRODUCTION.

The aim of this bulletin is to give a concise statement of the general operations connected with the production of pineapples in the field and on a large scale. The literature on this subject is limited and scattered through a score or more publications, thus putting it out of the reach of the man engaged in growing pineapples in the field.

A few pages of this bulletin are devoted to diseases, canning, and similar closely related topics.

No attempt is made to give information in regard to the growing of pineapples in glasshouses. Such information would be of little value to the people who grow this crop out-of-doors, as the method is so radically different that it should have a separate treatise.

Importance of the fruit.—The flavor of the pineapple is so agreeable that no one has to acquire a taste for it.

The time at which the main crop in the United States ripens has something to do with its popularity, as it comes into the market after the strawberry has become somewhat common and before the main shipping season for peaches. There are pineapples on the market the entire year, but those sold at other times than during the main-crop season are so high priced that the average man can not afford this luxury. The main shipping season is from the middle of April to the middle of July.

The area.—A considerable area in the United States is adapted to the cultivation of this fruit, and with the increased demand for it there can be no doubt that this will be greatly extended. The State of Florida doubtless contains the largest tract of pineapple land in one body. Southern California has some land that will produce pineapples profitably. All of Porto Rico and the Hawaiian Islands are free from frost, but the soil and climate are not uniformly adapted to the production of this crop. In the Philippines there is more land adapted to the production of pineapples than will be utilized for several generations. Mr. H. J. Webber estimated that Florida produced 3,000,000 pineapples in 1895, and the production has increased largely since that time. The Hawaiian Islands exported $14,423.17 worth of this fruit in 1897, according to the statement of Mr. Walter Maxwell. Much of this fruit was sent to California

Porto Rico, the Bahama Islands, Jamaica, San Salvador, and Trinidad contribute to the pineapple supply of the United States. Porto Rico is thought to be especially well adapted for the locating of canneries.

TERMS USED ON PINEAPPLE PLANTATIONS.

Every industry has terms that are used in a restricted sense, and this is true to a limited extent in the pineapple industry. The following terms are used more or less generally:

Rattoons.—When a bud occurs on the underground portion of a pineapple stem it produces roots by the time it gets to be 12 to 15 inches high. These make strong, vigorous plants, and are left in the field undisturbed unless too many occur together.

Suckers.—Plants produced from buds that originate from a portion of the stem above ground. These are nourished from the main plant and are late in producing their own roots if they remain attached to the parent plant. They are the usual commercial commodity. In buying pineapple plants, suckers are understood unless otherwise stated.

Slips.—These are plants that originate from buds produced at the base of the fruit. There is great variation as to the number of slips produced by different varieties and by different specimens of the same variety. Slips usually remain on the plant after the crop has been gathered, and often grow to be 8 to 12 inches long by winter. In the common varieties only the largest slips are used, but in the high-priced varieties all slips are saved and planted.

Crown slips.—These are plants that originate at the upper end of the fruit. In some of the varieties, such as the Enville, the crown is wanting and a tuft of crown slips is produced instead. Crown slips are utilized only in the high-priced varieties.

Crowns.—The tuft of short leaves at the apex of the fruit; wanting in some varieties, such as the Enville. It takes these a year longer to mature a crop than it does large suckers, so they are not employed extensively.

Pine.—The ordinary abbreviation for pineapple both on the plantation and on the market.

Sanded, or **sanding.**—Referring to sand being blown into the buds of newly set plants. (See diseases, p. 41.)

Spike.—A pathological condition produced by untoward fertilizer or soil conditions. (See diseases, p. 40.)

Shed.—A structure which produces half shade, used to equalize the extremes of temperature.

Tangleroot.—A condition in which the roots or part of them are wound tightly around the stem of the plant. (See diseases, p. 42.)

Spruce pine (*Pinus Clausa* (Englem.) Sarg.).—A species of pine restricted to the south Atlantic and east Gulf coast.

THE PINEAPPLE FAMILY.

This plant belongs to a very peculiar family, the Bromeliaceae, and is the most important species in the genus Ananas. In its original distribution the family was confined to the Western Hemisphere, mainly to South America, though the genus Tillandsia is represented by a number of species in the Southern States. As a whole, the family is either tropical or subtropical. The long moss, or Spanish moss (*Tillandsia usneoides* L.), is a peculiar plant common along the eastern Gulf and south Atlantic coast. This species of the pineapple family grows abundantly in the moister localities of the above region and is largely employed in that section for making mattresses and stuffing furniture.

This family is characterized by plants of an epiphytic nature; that is, those that grow on other plants but do not derive nourishment from them; but many of the species are terrestrial in their habits. In Florida they are frequently spoken of as orchids; doubtless due to the popular belief that all epiphytes are orchids, which is incorrect. The pineapple plant is terrestrial but might be looked upon as half epiphyte in that it will remain alive for months without being in contact with the soil. In contact with moist, loamy soil it soon sickens and dies.

It takes about four months from the time of blossoming to the ripening of the pineapple. The main season of blooming is during January and February, though occasionally plants bloom through the entire year, the least number occurring in November and December.

Immediately preceding the bloom a number of bright-colored leaves are produced as if to announce its advent. The blossoms proper occur in a head springing from the center of the plant. Their color is usually a purplish blue, though there is some variation even in the same variety. The blossoms though crowded into a head are quite distinct, each having its own insertion on the central axis. Each blossom is protected by a bract. The crown does not develop until later and its development does not depend upon the bearing of fruit.

The production of seeds in this fruit is rather the exception than the rule. Some varieties produce more seeds than others. While many of the species of this family have their seeds provided with a pappus of down for transportation, the pineapple seems to secure its dissemination by means of the fleshy edible fruit.

EARLIEST CULTIVATION.

The discovery of the pineapple, as a fruit, was coincident with the exploration of South America by the Spaniards. As early as the seventeenth century it was cultivated in Holland and in England, but its use was confined to royalty. Its cultivation in glasshouses did not become common in England until the beginning of the eighteenth cen-

tury. It is now grown by all the leading nations, either in glasshouses or in the open. In many instances it serves as an ornamental plant.

Outdoor cultivation of pineapples in the United States dates back to 1860. According to Taylor[1] efforts were made as early as 1850 to grow them in Florida, but for some reason they failed. It is now known that more than freedom from frost is required to grow pineapples successfully.

VARIETIES.

Different markets require different kinds of fruits; not that dealers disagree as to what constitutes a fine specimen, but that some markets are able to pay for a first-class fruit while another market can afford but a lower grade. The canneries in the large seaport cities of the United States can pay only the lowest price, so that they are obliged to use small fruit or that from an overstocked market. For shipping to European markets from the United States, none but the finest fruits that will stand the voyage should be selected. With the increased facilities for shipping by providing cold storage in transit and in erecting cold-storage plants in the European markets, these markets will be opened to our finer varieties of fruit in a more perfectly developed condition.

For distant American markets which have to be reached by express the medium sized fruit—about thirties—of the best shipping varieties will be found the most useful. There are many smaller cities in the United States where this fruit has not been in the market, and such places will not pay a reasonable price for a superior fruit, but will pay a much higher proportionate price for a medium sized specimen.

LEADING VARIETIES.

The number of varieties catalogued is not great, approximating one hundred. Some of these names are synonyms and others are known only in glasshouse culture. The pineapple, not being propagated from seed excepting for the purpose of originating new varieties, is a fairly uniform plant in its varietal limits.

Description of eighteen varieties.—The following descriptions are from the report of the Florida State Horticultural Society, 1900 (p. xvii):

(1) ABAKKA, fruit large size, oblong shape, orange-yellow color, best quality, ripens in midseason, plant of moderate vigor and very prolific.

(2) ANTIGUA, BLACK, fruit small size, oblong shape, color orange yellow, best quality, ripens in summer, moderately prolific.

(3) ANTIGUA, WHITE, fruit medium size, round shape, yellow color, good quality, ripens in midseason, a good cropper.

(4) BLACK JAMAICA, fruit medium size, oblong shape, orange-yellow color, good quality, ripens in midseason, a moderate cropper.

---

[1]Taylor, Wm. A., Yearbook U. S. Dept. of Agriculture, 1897, p. 328.

(5) BLACK PRINCE, fruit medium size, conical shape, orange-yellow color, fine quality, ripens in midseason, not prolific nor a vigorous grower.

(6) BLOOD, fruit small size, red-orange color, good quality, ripens in midseason, vigorous grower and quite prolific.

(7) CROWN PRINCE, fruit of medium size, conical shape, orange-yellow color, of good quality, ripens in midseason, moderately vigorous and fairly prolific.

(8) CHARLOTTE ROTHSCHILD, medium-sized fruit, conical shape, orange-yellow color, quality very good, ripening in midseason, vigorous plant and fairly prolific.

(9) EGYPTIAN QUEEN, fruit of medium size, conical shape, yellow color, good quality, ripening early, a vigorous grower and prolific.

(10) LORD CARRINGTON, medium-sized fruit, yellow color, conical shape, good quality, ripening in midseason, moderately vigorous and fairly prolific.

(11) PRINCE ALBERT, large sized fruit, orange-yellow color, fine quality, ripening in midseason, a vigorous grower and produces a good crop.

(12) PORTO RICO, very large fruit, orange-yellow color, variable shape, good quality, ripening in the early part of the season, produces a very large plant, fairly prolific.

(13) PERNAMBUCO, small fruit, of fine quality, fairly vigorous and a heavy cropper.

(14) RED SPANISH, fruit medium-sized to small, form somewhat variable, cone-shaped, color reddish-yellow, fair quality, ripens early, a vigorous plant and a prolific cropper.

(15) RIPLEY QUEEN, medium-sized fruit, conical shape, fine quality, ripens late and fairly prolific.

(16) SMOOTH CAYENNE, large sized fruit, orange-yellow color, very good quality, ripens in midseason, a vigorous grower and prolific cropper.

(17) SUGAR LOAF, small fruit, yellow color, quality very good, ripens late, moderately vigorous and a fairly prolific cropper.

(18) ENVILLE, medium-sized fruit, orange-yellow color, fair quality, ripens in midseason, moderately vigorous and fairly prolific.

The Red Spanish is undoubtedly the most extensively grown in the United States and may be considered as the standard variety for field culture. It is also grown under pineapple sheds, but sheds should be planted to varieties that produce larger fruits that sell for a higher price, such as the Smooth Cayenne. Pineapples, like other fruits, have varieties that seem to be better adapted for particular localities. Some of the varieties that prove successful under glass are failures when taken to the fields, while the pineapple shed seems to furnish conditions midway between the glasshouse and the open field, and thus proves to be a suitable place for some of the less robust varieties.

Mr. Webber, in his study of the effects of freezes on this plant, makes the following statement:

> Little difference could be observed in the hardiness of the different varieties other than that due to difference in size. The large plants were usually the least injured. Thus the Porto Rico, the largest variety grown, was probably the least injured. The Abakka and the Red Spanish probably come next in the order of size and consequent injury, but the difference is very slight.[1]

As all of our varieties are introduced, we may expect great improvement by way of breeding new varieties especially adapted for special

[1] Yearbook U. S. Dept. of Agriculture, 1895, p. 171.

needs and special localities. By growing the finer varieties under the sheds and selecting from these the hardier strains, more perfectly adapted varieties will be obtained.

The eighteen varieties listed by the Florida State Horticultural Society in 1900 are all of foreign origin. The report says:

> The Red Spanish, Porto Rico, Abakka, and Smooth Cayenne are grown most extensively for market. The Egyptian Queen, Ripley Queen, Blood, Pernambuco, and Sugar Loaf are grown less extensively. * * * In the numerous and expensive shedded pineries of Orange County and the West Coast, which are cultivated on the intensive system, the Smooth Cayenne is planted most extensively.

LINES OF IMPROVEMENT.

With a fruit so nearly perfect it would seem useless to attempt any improvement, but there are several directions in which there might be a change for the better. The new environment has laid the species open to new enemies and to new methods of attack from diseases, but this will be discussed under the heading of diseases.

Many of the finer varieties have originated in the glasshouse, and, having become accustomed to glasshouse conditions, are not profitable in the open or under sheds. Such varieties need to be changed by selection or crossing until they will become productive in the open. This can be brought about only by patient work and careful attention to breeding. Much of this work has already received thought and careful attention from this Department.

In the case of the Red Spanish the line of improvement will be in securing larger fruits and a better quality. The general method adopted for setting out fields is not conducive to the production of the best strains of a variety. As a rule the prospective planter buys the plants by the thousand, either delivered or at the railway station. The man who sells these plants is interested only in keeping his field properly stocked with plants and then to deliver them at the least expense to himself. This method of selecting gives the advantage to specimens that bear a small fruit or none, because the plant being less exhausted by bearing a small fruit is able to produce more suckers and of a larger size than the plant that has been reduced in vigor by bearing a large fruit. Thus, in a measure, have the pineapple growers been selecting from the inferior plants and starting their new fields from them. Since the demand for plants of this variety has been practically supplied, there is an opportunity to improve it by judicious selection.

The use of the proper fertilizer ingredients will likewise do much to improve not only the appearance of the fruit but also the taste.

Some of the varieties produce an abundant crop, but the fruits are either so small, or so uneven in size, that a great deal of care is needed to grade the crop properly, and even then much of it has to be thrown out because it is too small to pay to ship, and becomes a total loss.

One of the causes for this has been indicated in the above suggestion regarding the improper selecting of plants. Again, it may be due to carelessness in fertilizing. When it is due to unfavorable weather there is some difficulty in remedying the matter.

There is room for improvement in the quality of most of the varieties. In many of the fruits of the more hardy varieties the central stem is large, leaving considerable waste. This in itself is not so bad, but it is usually accompanied with a coarse fleshy portion which characterizes the inferior pineapple. The best remedy for this is to discard all plants producing such fruits.

CLIMATE.

To the general observer it may seem that a climate whose temperature never reaches the freezing point is all that is necessary to produce pineapples, but when the matter is studied more closely it is found that it requires more than temperature to produce pineapples. A matured leaf will lie upon a table in a dwelling for two months without decaying or drying up, but it will rot in less than two weeks if it be placed in an atmosphere saturated with moisture. Pineapple plants may be shipped from the Hawaiian Islands to Florida if they be kept dry. This fact merely indicates that the healthy pineapple plant does not suffer seriously from ordinary dry weather. It is one of the class of plants that prefers an alternating dry and wet season.

The culture of this crop should not be attempted in a latitude where winter frosts occur unless one is prepared to provide the proper protection. All of the region in Florida north of Palm Beach and Fort Meade are subject to occasional winter freezes which cause great losses to the pineapple growers unless their fields are protected by some artificial means. In this region there are some favored localities that did not suffer during the recent severe freezes.

Neither does the pineapple flourish in the extremely hot portions of the globe. Its largest acreage is confined to the islands or to the seacoast.

The best pineapple region in the world has a mean temperature of from 75° to 80°. Key West, off the coast of Florida, has a mean annual temperature of about 76°; Jupiter, in the midst of the pineapple region, about 73°. The mean annual temperature in a large part of the pineapple section of Florida is thus comparatively low.[1]

SOIL.

The proper selection of soil for pineapples is the most important problem in connection with their culture. The requirements of this plant in this respect are so different from the ordinary fruits that it took many experiments to convince the would-be pineapple grower

[1] Webber, H. J., Yearbook U. S. Department of Agriculture, 1895, p. 373.

that he has here a plant that demands a soil utterly intolerable to the ordinary crops of vegetables. This crop can be grown upon land that will produce ordinary vegetables, but the soil must be of a loose and open nature and not allowed to become water-soaked. It is not the fertility nor the humus in the soil that is detrimental to the pineapple, but it is the want of free drainage.

The soil prepared by the gardeners who grow this crop under glass illustrates this point. Their standard formula is about as follows: Two parts decomposed fibrous loam, one part well-decayed manure, another part one-half inch bones and pounded oyster shells. From this it is seen that even where the control over temperature and moisture is the most perfect the texture of the favorite soil is open and decidedly loose. The directions for watering are fully as interesting: "Moderately in winter and freely in summer."

Florida mainland.—The soil of the Florida mainland will be considered first, as it is more thoroughly understood than that of any other region. The following tables of the chemical analysis[1] of some typical Florida pineapple soils are exceedingly interesting, especially so from the fact that they show the soils deficient in every constituent that is thought to be a necessary element of plant food:

TABLE No. 1.—*Chemical analysis of pineapple soil, Brevard County.*

Type of soil.	Field.	Patches.	Saw Palmetto scrub.		Yellow soil.		White soil.		General subsoil.
Station number	Soil 12	Soil 13	Soil 21	Subsoil 22	Soil 38	Subsoil 39	Soil 40	Subsoil 41	Subsoil 37
Coarse earth	21.00	24.90	3.20	4.00	11.40	7.90	12.20	5.20	11.70
Fine earth	79.00	75.10	96.80	96.00	88.60	92.10	87.80	94.80	88.30
Humus	.24	.21	.71	.07	.18	.02	.16	.01	.12
Nitrogen	.0378	.0252	.0742	.0126	.0182	.000	.0042	.000	.000
Moisture at 100° C	.4000	.2940	.4880	.3140	.1820	.1000	.0400	.0080	.0925
FINE EARTH.									
Insoluble residue	97.5085	98.2100	92.3635	82.8206	97.2875	97.8545	98.6490	99.4480	98.2240
Potash (K_2O)	.0086	.0111	.0612	.0564	Trace.	.0077	.0034	.0048	Trace.
Soda (Na_2O)	.0510	.1285	.1911	.2150	.0516	.0492	.0714	.0344	.0781
Lime (CaO)	.2100	.1075	2.2325	7.5250	.0400	.0000	.0000	.0000	.0000
Magnesia (MgO)	.0225	.0099	.0207	Trace.	.0090	.0990	.0634	.0036	.0243
Ferric oxid (Fe_2O_3)	.2345	.1312	.6156	.3375	.8784	.8602	.1472	.3180	.7750
Alumina (Al_2O_3)	.1169	.0596				.4011	.1328	.0935	.3688
Phosphorus pentoxid (P_2O_5)	.0336	.0192	.0544	.0672	.0416	.0637	Trace.	.0160	.0112
Chlorin	Trace.	Trace.	.0086	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Sulphur trioxid (SO_3)	.0145	.0103	Trace.	Trace.	Trace.	.0060	Trace.	Trace.	Trace.
Carbon dioxid (CO_2)	.0000	.0000	1.6060	5.4280	.0000	.0000	.0000	.0000	.0000
Water and organic matter	1.7999	1.3127	2.8464	3.5500	1.8600	.6400	.7860	.1600	.6250
Total	100.0000	100.0000	100.0000	100.0000	100.1681	99.9840	99.8532	100.0783	100.1064

Table No. 2 compares the Florida soil with Hilgard's average. Dr. Hilgard obtained this average by combining 466 analyses of soils from the humid portion of the United States. He came to the conclusion that a soil which contains less than one-tenth of 1 per cent of either lime, potash, or phosphoric acid may be regarded as deficient in that particular substance. Referring to Table No. 2, it is seen that the

[1] Persons, A. A., Bul. 43, Fla. Agr. Exp. Sta., p. 664.

Florida pineapple soil is deficient in all the necessary elements except lime, and Table No. 1 shows that it is deficient in this element in the favorite class of soil (yellow soil).

TABLE No. 2.—*Comparison of Florida soils with Hilgard's averages.*

Substance.	Hilgard's average of soils.	Florida pineapple soils.		
		Soils.	Subsoils.	Mean of all.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Potash	0.216	0.0168	0.0230	0.0199
Lime	.108	.5180	2.5083	1.5131
Phosphoric acid	.113	.0298	.0489	.0393
Magnesia	.225	.0251	.0342	.0296
Nitrogen	.....	.0319	.0042	.0181

Table No. 3 gives the averages of the mechanical analyses of pineapple soils. The most striking peculiarity is the small amount of moisture and organic matter present. The small amount of moisture is doubtless due to the small amount of silt, fine silt, and clay contained in these soils.

TABLE No. 3.—*Mechanical analysis of soils and subsoils.* (*a*)

Substance.	West Palm Beach pineapple land.		Rockledge spruce-pine scrub.	
	Soil (0 to 6 inches, depth of).	Subsoil (6 to 36 inches, depth of.)	Soil (0 to 6 inches, depth of).	Subsoil (6 to 36 inches, depth of).
Moisture in air dried sample	0.15	0.07	0.15	0.25
Organic matter	1.21	.31	1.06	.45
Gravel (2–1 mm.)	.23	.06	.65	.66
Coarse sand (1–0.5 mm.)	3.02	3.08	12.36	9.07
Medium sand (0.5–0.25 mm.)	61.11	57.50	41.42	32.58
Fine sand (0.25–0.1 mm.)	33.76	37.78	41.18	52.13
Very fine sand (0.1–0.05 mm.)	.54	.59	2.40	3.26
Silt (0.05–0.1 mm.)	.22	.07	.16	.23
Fine silt (0.01–0.005 mm.)	.06	.13	.06	.18
Clay (0.005–0.0001 mm.)	.50	.52	.35	.51

a Division of Soils, U. S. Dept. of Agr., Bul. 13, p. 28. (Averages.)

How it is that pineapple plants can grow and produce a crop on a soil that seems to be so deficient in the chemical constituents that are necessary for plant growth has not been explained satisfactorily. It is true that heavy applications of the necessary elements of plant food—potash, phosphoric acid, and nitrogen—are made annually to maintain the productiveness of the fields, but the quantities added in the form of fertilizers would not amount to more than the chemists' "trace" when compared with the soil in which the plants grow; that is, the amount of these elements of plant food added in the form of fertilizers is so small comparatively that the chemist would not estimate it in the analysis of the soil to which it might have been added.

That this plant should need a soil of such mechanical analysis as is shown by Table 3 is not so surprising when it is remembered that it

belongs to a family a large per cent of whose members are epiphytes, i. e., grow upon other plants but do not draw nourishment from them.

Spruce pine as an index.—The inclination of the earliest pineapple growers on the mainland of Florida was to experiment with pines on the low islands east of the Indian River, which were thought to resemble the Keys more closely than the mainland. As they produced excellent oranges and large crops of vegetables, it was but natural to consider them a proper place to grow all crops for profit. After numerous failures on the islands it was discovered, almost by accident, that the spruce pine land on the Indian River contained the soil best adapted to the growth of this fruit.

The land with a yellow subsoil and covered with spruce pine mixed with a fair sprinkling of hardwood, such as hickory and scrub oak, is considered as made up of the ideal soil. In the interior of the State, where more careful attention is paid to the matter of irrigation and drainage, ordinary high longleaf pine land is used with good results. On soil with a hardpan subsoil it is necessary to bed the land up so as to insure prompt drainage during rainy weather. Any soil or condition that will hold water around the roots of the pineapple plant is certain to end in diseased fields and cause disappointment.

The Keys.—These are islands near the coast of southern Florida. They have a low altitude, often rising only a few feet above high-tide limits. They have a coralline foundation, making a rather porous substratum. Some of these Keys have large areas that are nearly ideal as a pineapple habitat. The proximity to water keeps down the high temperature in summer and their nearness to the trade winds induces a dry winter. In many cases soil, in the ordinary sense, can not be said to exist. In some instances the pineapple planter is obliged to choose the spot that has enough decayed vegetable matter to hold the plant in place on the coralline rock. The greater part, or nearly all, of the plant food is located in the small quantity of decaying vegetable matter; consequently it is soon exhausted. The question as to the best method of making these exhausted fields again productive has not been determined. The method usually followed is to abandon the worn-out field and clear a new one, but as nearly all of the available land has been cropped or is under cultivation it will be necessary to find some way of making these abandoned fields again productive.

Porto Rico.—The largest variety grown in the United States and Porto Rico originated in the Porto Rican islands, where a large portion of the soil is suited to its growth. According to Dr. S. A. Knapp, in his Report on the Agricultural Resources and Capabilities of Porto Rico, 1901 (p. 23), this fruit may be grown in all parts of this territory. The fertility of the soil will enable planters to grow pineapples there for an indefinite time without exhausting its resources.

Hawaii.—"In these islands the soil and climate seem to be as nearly right as could well be expected." According to Dr. William C.

Stubbs, it is "extensively cultivated, nearly every small farmer having a patch."[1] It is also reported that the plants have escaped from cultivation and are growing wild. The fact that plants may be shipped from the Sandwich Islands to Florida and sell for less than the home-grown ones illustrates the fertility of the soil and the suitableness of the climate.

Philippines.—"In Niihu and the Philippine Islands, where pine-apples succeed well, the soil is disintegrated lava covered with a layer of humus. There is but little cohesion in such soils, particularly when, as in this case, they contain considerable lime. When clay is present it is said to be important that it should not be so abundant as to hinder root penetration or to hold the soil water, but a certain amount to increase the water-holding capacity of the soil is apparently very desirable."[2]

To be successful in growing this crop it is necessary to be thoroughly acquainted with the needs of each individual field. This information can be obtained only by continued experience on the particular fields. In all sections there are spots in the fields that are liable to peculiar diseases, elevations that suffer during long droughts, or depressions that hold water too long during rainy weather. There are also variations due to gradations in the composition of the soil.

GATHERING.

It is not an unusual experience for the agriculturist to do all that is necessary to bring a crop to excellent maturity and lose it all or in part for the want of proper handling at the time of gathering. In no line of work is it more necessary to pay the closest attention to details in gathering than in growing tropical fruits. This operation is the one most directly under control, and yet it is the one most liable to be slighted. It is the operation in which judgment plays the most important part. It can not be learned except by experience.

Selecting.—The fruit should be dry when gathered. The first act in gathering is to select the fruits thought to be ripe enough to reach the market in the best condition. This is done by a laborer under the direct supervision of some responsible person who from time to time instructs him as to whether to select more mature or less mature specimens. The degree of maturity will depend upon the market to which the product is to be shipped and to the manner of shipping, whether by express, freight, or by water. In the summer, if the fruit is to go forward as freight it is selected when it is "just turning." If it is to go by water it is selected a little less mature, and if by express the fruit may be permitted to become "quite well colored." The matter of selecting depends so much on judgment that no fast rule can

[1] Bul. 95, Office Experiment Stations, p. 39.

[2] Webber, H. J., Yearbook U. S. Department of Agriculture, 1895, p. 273.

be laid down. The distance from the market, the condition of the weather, and the variety planted are all factors which must be considered.

Care in handling.—Handling begins when the laborer has seized the fruit to be broken, and ends, so far as the grower is concerned, when the fruit is on the railway platform or on the steamboat dock. The laborer who goes among the fruit is usually provided with a pair of leggings that reach above the knees and a pair of mittens made of canvas.

He seizes the pineapple usually in both hands, and gives it a slight twisting bend to cause the stem to snap off a half inch or so below the fruit. "Breaking pines" requires skill and attention. If the stem be broken off too near to the fruit it is apt to rot in transit, and if the stem is broken too long it has to be broken again at the shed at a loss of considerable time. Only the more intelligent and better laborers are sent into the land to break or to cut pines. After breaking, the pineapples are tossed to a laborer standing in the pathway between the beds, who catches them and lays them down carefully. From this place they are collected in large baskets or in field crates and hauled to the packing shed.

In gathering some of the fancy varieties the stems are cut several inches long, the fruit taken to the packing house, and the stem cut off even with the fruit. In some cases the cut ends of stems are covered with paraffin wax to prevent, as much as possible, evaporation and the loss of flavor. Under proper conditions it pays to take all of these precautions, but for the ordinary fruit the advantage gained would not be worth the time consumed.

Grading.—At the packing house the fruit is sized and sorted. Under ordinary circumstances there are only two grades, fruits and culls. It sometimes happens that the pineapple grower has three grades on hand besides the culls—ripes, greens, and mediums. The first grade must be packed and sent out as soon as possible, either by express or to some near-by market. The mediums allow more choice of method of shipping and of market. The greens may be kept in the packing house until they have ripened to a suitable degree, or they may be shipped by freight to the most distant market ordinarily supplied.

In sizing, the fruit is known by the number it requires to fill a half-barrel crate, viz: 18's, 24's, 30's, 36's, 42's, 48's, and 54's. The last-named size is not crated unless the crop is very short. There is no machine which can be used to determine the sizes, so this has to be done by guessing the grade to which the particular fruit belongs. The laborer who does the sizing soon becomes expert at the practice, so the wrappers find no great difficulty in packing the fruit.

Wrapping.—Pineapples that are shipped in crates are usually wrapped in some kind of paper, the grade varying with the taste of the grower

and the quality of the fruit shipped. Red Spanish are usually wrapped in ordinary brown straw paper, fine smooth Cayennes and Queens in a number of thicknesses of finer paper, and some are wrapped in tissue paper stamped with the plantation name. It is quite important to wrap pineapples to keep them from breaking the skin of one another in transit. In addition to lessening the danger of breaking the skin the wrapping protects them from wilting and from dust while being shipped and carted. Pineapples sell largely upon their looks.

Packing.—The sizes of packages adopted by the Florida growers are the barrel and half-barrel crates. The former is 12 by 20 by 36 inches; the latter, 12 by 10 by 36 inches. The latter size seems to be the one in most general use. This is undoubtedly the more convenient size, as the unit of this size holds about as much fruit as the ordinary fruit dealer or grocer wishes to have on hand at one time, and it makes a convenient size to handle. As the industry is extended, more attention must be given to the convenience of the individual and small buyer.

In packing a crate the fruit must be pressed down firmly so it will not shake in transit, and, on the other hand, it must not be squeezed down to the extent of mashing or bruising. The method varies greatly with the particular variety packed and the quality of the variety. Some of the fine large varieties when quite ripe have to be wrapped in two or more thicknesses of soft paper and then packed in excelsior or Spanish moss. This adds greatly to the cost of packing and preparing for market, but is usually more than compensated for by the higher price they bring.

For long distances.—Fine specimens of fruit that are to be shipped a great distance need special preparation to stand the trip. When the fruit is sufficiently fine to pay the cost, and sufficiently mature, the plant is cut off at the ground and the whole wrapped carefully and packed firmly in a crate or barrel. Sufficient ventilation is allowed so the plant will continue to live during transit. This method of packing for shipping requires experience and care. The vitality of the plant will be drawn into the fruit during transit, serving to mature it in a way much more like the fruit that is matured on the plant in the field than the fruit that is cut from the plant and allowed to mature in that way. Simmonds, in Tropical Agriculture, mentions another way that is practiced in shipping fine fruit from the Azores. He says that the stalk is cut several inches below the fruit and an ordinary large-size flowerpot is then filled with mold, into which the stalk is inserted. These are then shipped in skeleton cases to avoid bruising or injuring, the fruit being wrapped in paper to further insure its safety.

The benches.—The tables or benches on which the fruit is delivered from the field should be built about 30 inches high on the side where the laborers stand who do the wrapping work. The top should have

pitch sufficient to cause the fruit to roll to the front of the table. These tops may be made of 1-inch stuff, 1, 2, or 3 inches wide, the upper corners rounded. These strips are fastened crosswise of the table and covered with coarse cloth, such as fertilizer sacks are made of. On the front of the table is an 8 or 10 inch board to prevent the fruit from rolling off. The width of the table varies to suit the covenience of the packing house, usually about 40 inches.

The benches are usually built along the walls of a shed at a siding, on two or three sides, as may be most convenient. Such sheds are furnished by the railroad company usually, or they may be private property and located at a siding. During the shipping season work is so pressing that it is not practicable for more than one grower at a time to use an ordinary shed. The fruit from the smaller field has to be hauled to the siding or to a depot.

SHIPPING.

This fruit will stand more rough handling and keep for a longer time than any other tropical fruit that is transported in the fresh condition. The length of time that a good pineapple will keep depends greatly on circumstances, but in a dry atmosphere, such as an ordinary living room, a fruit free from bruises may be expected to keep for two or three weeks from the time it is picked for shipping. Its ability to stand rough handling and its good keeping qualities make it possible to ship it to the centers of population of all the great nations of the world. Europe is supplied mainly from northern Africa, the Madeiras, the Canaries, and the Azores; the eastern portion of the United States is supplied from the West Indies, the Bahamas, and from Florida, and the western portion of the United States from the Hawaiian Islands. A large area of our country is still left unsupplied.

In crates.—The larger portion of the fruit comes to the market in crates, and this is the only way in which it should be shipped except when the poorest grades, that are used for canning, are being handled. The crate makes a good unit for quotations, for transportation rates, and for the commission merchants. It also gives the individual an opportunity to establish a reputation and the buyer a good chance to trace back any fraud that might be practiced by an unscrupulous planter. This "handy package" has done more to extend the trade in fruits and vegetables than would at first seem possible. The trade-mark of a particular planter may at first seem a useless expense, but it has proved advantageous to many orange growers. In some cases the markets know the trade-marks so well that the fruit sells upon them without further inspection. Some of the orange growers have customers whom they supply directly, thus saving the commission merchants' fees and having a definite market for their product.

In bulk.—In the Bahama Islands and the West Indies the greater part of the fruit is still shipped in bulk. This, of course, discourages

the growing of any but the more prolific and coarser varieties. The fruit produced on the Keys was shipped in this way until quite recently. It was loaded into small sailing boats and taken to Key West or some other near-by port, and there packed for the regular market or loaded onto larger vessels and taken to Northern markets and sold in bulk to canneries or to men who reshipped it to the consuming markets. This method of shipping is not only unsatisfactory, but very liable to lose a large part of the shipment.

By freight.—The bulk of the crop goes into the market as freight. For this purpose special trains are put on to pick up only pineapples. These trains start out early in the morning, but since there is a "siding" or depot every mile or two in the pineapple belt it is well into the heat of the day before the train begins to make much headway. After the train has gotten out of the pineapple region it makes good time, so that there is no great loss, ordinarily, from delay in forwarding by freight.

The railroad laborers are inclined to handle the crates of fruit rather roughly, but the grower can minimize this by his presence and attention. The crates are so packed in the car, if it is a through car, as to give considerable ventilation. This, together with the spaces between the slats of the crate, allows the moisture to escape to some extent, and so keeps the fruit dry and from sweating even though the weather be somewhat warm.

By express.—This is the ideal way of shipping, and although expensive, is still in many cases profitable. Pineapples that are too ripe to go forward by freight may be shipped by express. The fancy varieties that command high prices are usually permitted to develop until quite ripe before gathering, and such must be forwarded in the most expeditious way possible. Where they are bought directly by the consumer they are scarcely more expensive than those shipped by freight and obtained from the dealers.

COLD STORAGE.

Experiments in keeping pineapples in cold storage in this country seem to be wanting. It seems quite probable, however, that this method may be developed when the fruit shall become sufficiently abundant and the cold-storage plants sufficiently numerous.

The experiment has been tried in New South Wales and reported upon favorably. Since this fruit may be obtained at all times of the year no great effort in this direction need be expected until the demand shall have been supplied during the season in which the greater part of the crop ripens.

MARKETS.

With increased facilities for distribution the markets are being greatly extended. The question of making the pineapple a fruit to

be universally used depends entirely upon being able to distribute it to all portions of the world at a price that brings it within the purchasing power of the inhabitants. As the transportation becomes cheaper and more expeditious the area to be supplied becomes greater.

In America.—During the time of slow sailing vessels and uncertain railroad transportation the markets in this country were limited to the Atlantic seaboard and the ports of the Gulf coast. Since the advent of the steamship and close railroad connection the cities as far inland as Chicago, St. Louis, and Minneapolis have been regularly supplied. From these as centers the secondary cities are furnished, but no special effort has been necessary to get rid of the fruit, so the inhabitants of the smaller cities and towns rarely have an opportunity of purchasing it.

The west coast of the United States is supplied mainly from the Hawaiian Islands.

In Europe.—The markets of Europe are regularly supplied from Madeira, the Canaries, and the Azores. Large shipments are also made annually from Jamaica, Trinidad, the Bahamas, and the West Indies. Trial shipments have also been made from the United States, and it has been fully demonstrated that the markets of Europe are not too far off nor too difficult to reach when the needs of the United States shall have been supplied. The common varieties and inferior fruit will never be profitable for this market, but we shall have to produce a finer fruit at a lower price than is produced in the Tropics.

PRICES.

The price paid for pineapples varies with the time of the year and the market to be supplied. The fancy market will pay a handsome price at any time for superior fruit. During the winter months the prices are better than during spring, summer, and fall. The reason for this is partly because the markets are full of other desirable fruits at these seasons and partly because the supply of pineapples is limited during the winter. Fifty cents apiece, even in Jacksonville, Fla., during the winter is a common price for a pineapple that weighs 8 or 10 pounds. Just before Christmas the prices run up to $6 and more a crate for fine fruit. Christmas is a time of high prices for all rare fruits, and these prices must be regarded as somewhat abnormal.

Medium-sized fine fruit brings a good price at all times, rarely less than $2 to $2.50 per crate, while the small fruit sometimes sells too low to pay for gathering and shipping. The product brought into the markets for canning is usually sold in bulk, either by weight or measure.

COST OF ONE ACRE.

Pineapple growing as a systematized industry is so new that it requires great care and constant attention to avoid failure. Enough

failures have occurred to show several ways in which we should not go, but as a whole the most desirable plan has not been reached except by a few men. The markets are still able to take all the good fruit offered at a price that leaves some compensation to the grower. The question, then, of financial success is not so much of being able to sell a good product as to produce one.

The outlay per acre.

Cost of land	$1.50 to	$80.00
Cost of clearing	20.00	60.00
Cost of plants	25.00	800.00
For fertilizer	20.00	150.00
Freight, express, etc	20.00	80.00
Labor	25.00	75.00
Shed	325.00	600.00
Total	436.50	1,845.00

This estimate does not include the salary of the superintendent. The first column is about as low as one would be safe in estimating; while the amount might easily exceed the figures in the second column.

The receipts.

For plants	$ 00 to	$1,500
From fruit	150	750
Total	150	2,250

The amount given in the second column has frequently been exceeded, and, under what appeared to be very favorable circumstances, an amount less than that given in the first column has been realized from the sale of products from an acre.

In Porto Rico, Hawaii, the Philippines, and on the Keys the largest item of expense, the shed, is not incurred. To produce good fruit, such as is demanded by the fancy markets, the cost per acre can not be reduced below $100. If the soil be fertile enough to grow a crop without fertilizer the cost of clearing will be greatly decreased. From the figures here given it will be seen that it requires considerable capital to grow pineapples extensively.

STARTING WITHOUT CAPITAL.

The figures seem almost prohibitive to many farmers, but it has been demonstrated repeatedly that a willing laborer may become a pineapple grower. The absolute outlay in money may be reduced to the cost of the plants, the cost of the fertilizer, and the cost of land. This puts the cost for the first year at about $50, and to carry this forward to the ripening of the first crop about $20 more should be added, making an outlay of $70 to produce the first crop on an acre. In the pineapple-growing section of Florida there is sufficient demand for

labor to more than keep a man while he is growing his first crop. Another plan adopted is for two persons to form a partnership, one working to supply the needed cash while the other grows the crop of pineapples. After the first crop has been produced the increase in the number of plants will permit the extension of the area as rapidly as financial conditions will allow. The one great drawback to the average man's succeeding in pineapple growing is that the returns come in at one time and during a short period. So it is a case of labor and wait for about eleven months in the year for the returns during the twelfth month. The character of the pineapple land does not permit many other crops to be grown upon it successfully; consequently the greater number of pineapple growers have to depend on this crop alone.

FERTILIZERS.

This term is applied to manures or substances used in the place of manures. Those that are put up and sold on the markets are known as commercial fertilizers. The most difficult problem in connection with the commercial growing of pineapples in the United States is the proper use of commercial fertilizers. The chemical analyses of pineapple soils show conclusively that something must be added to the soil before it can be productive (see pages 12 and 13). A soil so nearly devoid of all the elements necessary to plant growth would, at first sight, be considered the most unreasonable place to plant anything, but the pineapple, and other fruits as well, are made up of about 90 per cent of water, and less than 1 per cent of them is made up of the mineral matter which is added as a fertilizer. The amount of nitrogen (ammonia) is also very small. Since these elements that have to be supplied do not cost a prohibitive sum and water is free usually, the need of commercial fertilizers becomes an advantage rather than a drawback. Plants will take up almost any soluble matter present in the soil at their roots, so that if a pineapple is placed in a soil which is naturally fertile this will absorb the plant food regardless of the fact that it may make the fruit insipid or nearly nauseous; but if we have a soil in which there is no such matter to be taken up we may supply those substances that will give the fruit the desired flavor and keep it from ripening flat and insipid.

There is considerable land that produces good pineapples without the use of any fertilizer, but it appears that the best and finest pineapples and likewise the largest crops are produced on land that has to be heavily fertilized. Soils that are normally fertile become deficient in some one or more of the constituents necessary to make them productive. The soil need not be entirely deficient in the amount of the elements required, to be unproductive, but these elements may be present in such a combination that the particular plant may be unable

to appropriate them. It is possible, therefore, that a particular soil may have a large quantity of a certain element and yet be benefited by an application of that element in a different form.

In studying the effects of fertilizers it is always important to take into consideration the kind of soil, the amount of cropping that has been done on it, the location, and even the varying conditions of the same field. Nor should too much confidence be placed in the results of one or two years' experience. The pineapple soils of New Zealand appear to be abundantly supplied with potash, while those in the United States seem to be deficient in this element. There are fields that have raised several crops without the addition of this element except in a limited amount in the form of cotton-seed meal or tobacco stems. The latter substance contains a considerable quantity of potash, but in the cases referred to it was used only as an insecticide, and, therefore, in a small quantity.

COMMERCIAL FERTILIZERS.

The greater number of commercial fertilizers are sold as complete articles—that is, they are supposed to contain in proper proportion every element of plant food that the particular soil needs to make it produce pineapples.

The general reports as to what fertilizers are the best are very conflicting, and even the reports as to what fertilizer elements are required by a particular soil are not uniform. These conditions arise partly from an imperfect understanding of what the fertilizer is supposed to supply and partly from the variable conditions attending different applications.

The pineapple soil of the mainland of Florida is so nearly sand and insoluble matter that it is the ideal soil in which to experiment with fertilizers on this crop.

Time of applying.—The time of applying the fertilizer is by no means well understood; so we may find people applying it at all times of the year with precisely the same end in view. Many growers prefer to make one application during November or December and another just after the crop has been gathered. Others make only one application, and that during the summer or in the early fall. Other growers make three applications—one just after the crop has been shipped, the second during the fall, and the third in the spring or winter just before the blooms appear. Even among the growers that make the same number of applications there is no uniformity. The practice among the different growers is so variable that it is not improbable that a fertilizer properly prepared may be used at any time of the year with good results, although there may be a time of the year or condition of the soil when the fertilizers will prove to be of greater value than at any other time; also this time must be ascertained independently

for each section and possibly for each field. It does not now seem probable that any fixed rule will ever be formulated for this operation that will not involve considerable loss at times. Experiments will doubtless be able to demonstrate what substances are best for producing certain kinds of fruit, but the amounts of those substances dissipated or wasted by conditions not under control will not be determinable. In addition to this, there is an amount of fertilizer and a kind of fertilizer that will produce a maximum of plant growth consistent with the best economy.

AMMONIA.

The terms nitrogen and ammonia, as used by the fruit growers in connection with fertilizers are nearly synonymous, the only difference being that a fertilizer which contains 5 per cent of ammonia, when expressed in the term of nitrogen, contains about 4 per cent (4.059 per cent) of nitrogen. When the term ammonia is used it does not mean that the nitrogen present is there in the form of ammonia, but it is simply a way of designating the amount of ammonia that would be present if the nitrogen present were combined with the necessary amount of hydrogen to produce ammonia. The fact that larger figures are required to designate the amount in the form of ammonia than in the form of nitrogen has had something to do with the general introduction of the term.

Cotton-seed meal.—This substance is used mainly for its nitrogen content, though it contains a small percentage of potash and phosphoric acid. Some land, especially new land, is capable of producing a first-class crop with no other fertilizer, but it is quite probable that nearly all Florida pineapple soil needs potash, and possibly phosphoric acid in addition, to produce a maximum crop. As a substance to be dropped into the bud of newly set pineapple plants to furnish a small amount of fertilizer and to protect the buds against sanding, it is preferable to anything else now in use.

Dried blood.—The nitrogen content of this substance is quite high, running from 10 per cent to 14 per cent. The amount of potash and phosphoric acid present is so small that it is usually not considered. The nitrogen from this source is liberated somewhat slowly, which is a point in its favor. It contains from two to two and a half times as much nitrogen as cotton-seed meal contains, a consideration not to be overlooked; for all the fertilizer has to be applied by hand and shipped a long distance. It may be applied directly into the bud without harm to the plant. As a fertilizer it possesses all the advantages that cotton-seed meal has and is more concentrated.

Blood and bone.—This fertilizer as found on the market contains an indefinite amount of dried blood mixed with ground bone and fre-

quently with inert material to give it bulk. In using this substance or mixture it is best to secure information as to its composition from some reliable source. In addition to the value of the dried blood, the ground bone contains some nitrogen and some insoluble phosphoric acid, which the pineapple plant seems to be able to assimilate, at least in a small degree. This form of fertilizer can also be applied directly in the bud without injury to the plant.

Nitrate of soda.—This is a concentrated form of nitrogen. When applied it must be done with care, as it is quite caustic to the pineapple plant, and if applied in the bud is apt to kill it. As a source of nitrogen it is quickly available and not considered lasting. If used, a number of applications should doubtless be made during the season. Large applications should not be made nor should it be left in bunches, but distributed evenly and mixed thoroughly with the soil. When pineapple plants appear to be growing too slowly they may be "forced" along by an application of nitrate of soda. A little experience with nitrate of soda and a knowledge of previous fertilizations will enable one to use it to good effect. Some caution is necessary in using nitrate of soda, as it produces luxuriant growth, but a tender plant.

Sulphate of ammonia.—This is the most concentrated form of nitrogen that is used as a fertilizer. It contains about 20 per cent of nitrogen. As a fertilizer for pineapples it does not seem to produce as good effect as nitrate of soda, and is usually applied in combination with other substances; that is, as a mixed fertilizer.

POTASH.

This substance is found in insufficient quantities in most of the pine apple land on the South Atlantic seacoast. In the island pineapple regions the soils have not been tested sufficiently to know definitely just what is needed. In New Zealand the soil does not seem to be benefited by an application of potash, and this will doubtless be found true also in the Philippines and in the Hawaiian Islands or in other volcanic regions.

Kainit.—This is a mineral substance composed of several salts in combination as found in the mines. The principal constituents are potassium sulphate, magnesium sulphate, magnesium chloride, and a small amount of potassium chloride. A strong objection to its use is that it contains only a small percentage of potash, there being usually less than 12 per cent. It does not seem to be the best source of potash for this crop, but why this is so does not seem to have been determined. The percentage of potash is too low to permit its use in the greater number of mixed fertilizers. As a fertilizer, or an ingredient to use in combination, it will be advisable to avoid it, at least for the present.

Carbonate of potash.—This form of potash is not on the market extensively, but is one of the best forms for pineapples. It contains about 18 per cent of potash.

Low-grade sulphate of potash.—This fertilizer is also called the double potash salts, being a sulphate of potash and of magnesia. In addition to the beneficial effects derived from the potash contained in it, the magnesium sulphate is supposed to have some beneficial effect upon this crop. The amount of potash present varies from 22 to 26 per cent. As the price of the potash salts is fixed by the amount of potash present, it may be advantageous to buy this form to secure the advantages of having the magnesium sulphate present.

High-grade sulphate of potash.—This substance is composed almost entirely of the sulphate of potash, and usually contains more than 95 per cent of sulphate of potash, or nearly 50 per cent of potash. From the standpoint of bulk this would be considered a more economical fertilizer than any of the foregoing, having almost no waste product to handle. Its reputation among pineapple growers is good.

Muriate of potash.—This salt is known to the chemist, and to some extent to the pineapple grower, as potassium chloride. It contains nearly 50 per cent of potash, and so is a fairly pure substance. As a potash fertilizer it is well thought of by many growers; by some it is believed that the pineapples grown on land fertilized with it are tender and "bleed" easily.

Ashes.—Various forms of ashes are offered for sale in the markets. They have no value, as a rule, beyond their potash content. They are sometimes used for insecticidal purposes, but can not be recommended for that purpose. They may be obtained from cotton-seed hulls, hard wood, saw palmetto, and other sources. The potash content of the cottonseed-hull ashes is fairly constant, but that of the hard wood and saw palmetto are exceedingly variable. Cottonseed-hull ashes may contain as high as 20 per cent of potash, but that of hard wood will not average much over 8 or 9 per cent. Ashes are undoubtedly good fertilizers for pineapples, but their reputation has been greatly damaged by large quantities of poor or worthless ones being placed on the market. Any one desiring to use ashes as a fertilizer should secure a guaranty from a reliable source that the particular shipment that he expects to buy has not been leached and that it contains a certain quantity of carbonate of potash.

PHOSPHORIC ACID.

The amount of phosphoric acid needed by the pineapple plant for its fruit seems to be only one-tenth as much as the amount of potash. If cotton-seed meal is used as a source of nitrogen it will supply nearly as much phosphoric acid as seems to be needed, judging from a chemical analysis of the fruit.

Bone meal.—Ground or pulverized bone has long held an important place as a fertilizer for general farm crops but has not been recommended extensively for a pineapple fertilizer. The esteem in which it is held as a general purpose fertilizer places its price considerably above what the pineapple grower can afford to pay for it, at least from a technical standpoint. Its value as a fertilizer on our present basis of calculation would put it at about $12 per ton, which is much below its market price. The question as to whether the phosphoric acid it contains is available to plants or not has not been definitely settled. The good effect upon pineapples produced by bone meal seems to be greater than can be accounted for on the theory that the nitrogen contents is all that is available to the crop.

Acid phosphate.—Dissolved rock has been used so extensively in fertilizing crops that it has been considered as an essential constituent. Experience has shown, however, that this form of phosphoric acid is injurious to the pineapple crop under the Florida east-coast conditions. For a time it was thought that the acid phosphate contained free sulphuric acid and that this was the cause of the injury, but by doubling and quadrupling the amount applied it was demonstrated that the cause for the unusual behavior of the plants after the addition of phosphoric acid must be explained in some other way. The experiments demonstrated, however, that the source of this element, phosphoric acid, should be sought elsewhere.

Other sources.—Guano, or the dung of sea fowl that has not been leached is also an excellent source of phosphoric acid. Its high price has kept it out of the hands of the pineapple growers.

Fish scraps have been utilized to the best advantage. The whole carcasses of otherwise worthless fish may be used as a fertilizer.

REMARKS ON COMMERCIAL FERTILIZERS.

From extensive experiments carried out by the Florida Experiment Station under the charge of the writer it seems that blood and bone gave the best results as a source of ammonia, nitrate of soda stood second, and cotton-seed meal third, while sulphate of ammonia stood last.

Of the forms of potash used the potassium magnesium carbonate stood first, low grade sulphate of potash second, high grade sulphate of potash third, muriate of potash fourth, and kainit last. Bone meal gave better results than did acid phosphate.

In a general way blood and bone gave good results with any form of potash. Nitrate of soda in combination with acid phosphate or with kainit did not seem to do well.

Just why these combinations did not do well has not been explained. The general deductions obtained from the experiments on the sandy

soil of the east coast will be of great importance in understanding the fertilizing of pineapples on other soils.

WHO SHALL MIX THE FERTILIZER?

The appliances necessary to mix fertilizers consist merely of a good packing-house floor and an ordinary sand screen, such as is used by plasterers. One hundred or 200 pounds of different elements may be mixed at a time. The fertilizer houses make a point that the pineapple grower can not mix the elements evenly, but by running the fertilizer through such a screen several times the material will usually be mixed sufficiently if all the elements were present in the proper proportions in the beginning. As a rule, two or three thorough screenings is all that a mixture needs.

There are reliable fertilizer houses which will mix any combination of fertilizer elements for an additional cost of $1 per ton over the amount that the elements cost in their establishment. We have no evidence that the pineapple fertilizer improves by being kept after it has been mixed, nor is there any reason why each element should not be added separately as the particular part may be needed by the growing plants. Above all other ordinary considerations the pineapple grower should know the origin of each element in his fertilizer, and the fertilizer house ought to be required to guarantee this before the fertilizer is purchased, if one buys a prepared pineapple fertilizer. It is much more important with the pineapple crop than with the truck crops, and it is fully as important as in a tobacco or an orange crop.

FERTILIZER FORMULA.

The formula given below is thought to be such as will supply the needed amounts of plant food to soil that is nearly destitute of the principal forms—nitrogen, potash, and phosphoric acid.

The pineapple grower is the only one who is able to tell whether his particular field needs more potash, more phosphoric acid, or more nitrogen, and he can tell it only after definite experiments. The following formula will be found useful:

	Per cent.
Ammonia	4
Potash	6
Phosphoric acid	1

Use about 1,000 pounds per acre of the above formula for the first application, after the plants have been set out and are well rooted. Use about 1,500 pounds for the second application, and then determine from results whether to increase the amount for the third application or not. These figures and formulæ are approximate only and may not be equally good for any two fields or for any two lands of the same field.

AMOUNTS OF DIFFERENT FERTILIZERS.

The following statement shows the amounts of different fertilizers that should be used for an acre:

As source of ammonia—
- 500 pounds blood and bone, or
- 200 pounds dried blood, or
- 150 pounds nitrate of soda, or
- 400 pounds cotton-seed meal, or
- 120 pounds sulphate of ammonia.

As source of potash—
- 350 pounds carbonate of potash, or
- 250 pounds low-grade sulphate of potash, **or**
- 120 pounds high-grade sulphate of potash, **or**
- 120 pounds muriate of potash.

As source of phosphoric acid—
- 120 pounds bone meal, or
- 120 pounds guano (bird dung), or
- 120 pounds dried fish scraps.

If blood and bone be used as a source of ammonia the bone will doubtless supply a sufficient amount of phosphoric acid.

If cotton-seed meal be used as a source of ammonia there seems to be no good reason for adding any substance to secure more phosphoric acid; that is, cotton-seed meal and a potash seem to form a complete fertilizer for pineapples.

If guano or fish scraps be used as a source of phosphoric acid the amount of ammonia-furnishing substance should be decreased by one-third.

From the experiments completed the indications are that the amounts named in the foregoing table are approximately what is needed on an acre of a good quality of spruce-pine land. The substances thought to be best are named first under each fertilizer element.

HOMEMADE FERTILIZERS.

These usually include the manure from domestic animals and the decayed mass from straw or other organic matter that has been collected for other purposes than that of the manure or fertilizer produced. At times this vegetable and animal matter is collected on purpose for the rotten material that it will produce. This material is sometimes mixed or composted with commercial fertilizers to give to the material the elements needed for plant food.

This kind of fertilizer is excellent for pineapples, but the supply is so limited that it is scarcely worth considering. When homemade fertilizers are used the vegetable matter should be thoroughly rotted before it is applied.

Eelgrass and seaweeds generally give good results especially if used in a well-decomposed state. In most cases, however, the advantages

from the use of these marine plants is not commensurate with the cost and trouble of applying.

MULCHING.

Most fruit crops take kindly to a good coating of mulch, and the pineapple is no exception to this rule. After the first crop has been gathered most of the old foliage dies and makes a covering for the soil. The leaves of the old plant do not die until the young plants that have started from them have exhausted the old plants. By the time the second crop of fruit is maturing the leaves of the plants that produced the first crop form a considerable mulching. To this will be added from year to year the leaves and stems of the plants that have produced a crop. In the course of five or six years this makes a considerable covering over the ground or humic addition to the soil. Any protection of the soil from the direct rays of the sun is a benefit, but a mulching adds to the soil a small quantity of organic matter. The beneficial effect of this is very striking.

The application of organic matter for the purpose of mulching is the exception. Mulching material is both difficult to obtain and hazardous to use. The danger from fire is so great that no one would wish to apply it on a large scale. In some instances fires destroyed so many plants that less than half the area burned over could be set out with the remaining plants. The cases referred to were in fields where no mulch had been applied, but the fire caught in dead plants.

THE LAND.

The places where this crop grows seem to be the most unlikely ones for the cultivation of any fruit or vegetable. This is doubtless the reason for so many surprises in pineapple propagation. Its native haunts appear to be in the shade of dry forests in some of the tropical countries of America. Its near relatives live in moist atmospheres but in dry locations, in such places as on tree trunks and boughs, and at the feet of trees.

Clearing.—One of the first requisites of the land is that it should have a free circulation of water. The soil may become thoroughly soaked, but it must not be filled with stagnant water. Such land has, as a rule, very little heavy timber upon it, and so does not prove difficult to clear thoroughly, and when once cleared it does not send up many suckers.

The first work of clearing is to remove all large trees and shrubbery, digging them out by the roots, or at least cutting the roots deep enough under ground so they will not be struck by plows or other implements. The stumps of the larger pine trees, especially if they are over 10 inches in diameter, are usually left. It does not pay to remove these unless more abundant than usual, and in three or four

years they will be rotten and the pines will have spread over the place previously occupied by the stump. So much of the cultivation and other operations is by hand that not much interference with the work results. After the grubbing has been done and all visible obstacles, excepting the large stumps mentioned, have been piled up they are burned. This clears the field of nearly every vestige of wood or other material that would obstruct work in the field. The land is then plowed deeply and carefully, and the plowing locates any roots or stumps that may have been missed in the first work, especially the roots and underground stems of many vines, such as the china briar (*Smilax* sp.), gopher apple (*Chrysobalanus*), and perennial herbaceous plants that happen to be dormant at the time of clearing. The large quantity of this material taken out at this time is burned when sufficiently dry or when convenient. If the pineapple soil contains much vegetable matter, which is an unusual thing, it is better to remove the trash from the pineapple field before burning it. Usually there is nothing in the pineapple soil that can be damaged. Finally, the land is raked over with a wooden hand rake to take off the last vestige of trash or ash piles that might prove an obstruction.

The cost of clearing pineapple land varies with the character and amount of growth. Poor pineapple land has been cleared for as little as $8 to $20 an acre and land with a heavy mixed growth may cost for clearing as much as $80 per acre. The average land will cost somewhere between these figures for clearing. Where the land is rocky in addition to the native vegetation the cost of clearing is greatly increased and may amount to as much as $200 per acre.

On the Keys.—The method of clearing on the Keys is very different from that on the mainland. Here is a coralline-rock foundation with little or no soil upon it, so that plowing and grubbing are impracticable. The pineapple grower therefore cuts the vegetation during the growing season, and when it is thoroughly dry it is set on fire. This burns all the cut material and destroys most of the remaining vegetation. While this method of clearing is very simple and primitive it is the only one practicable. There being only a small amount of vegetable matter or soil present the field becomes exhausted soon. The land is then thrown out to be reclaimed by nature and a new field is cleared, which in turn is thrown out when it becomes exhausted. This process can not be continued indefinitely, since the area of the Keys is limited.

LAYING OFF THE LAND.

After the field has been thoroughly cleared it is laid off into lands of widths to suit the purposes of the planter. A favorite distance, where the field is extensive, is to lay the lands off about 60 feet wide. This leaves a distance of about 30 feet for the man who breaks the

fruit to toss it to the man in the pathway—one side of a land being picked over at a time.

The lands are laid off in varying checks, favorite distances being 18 by 18 to 22 by 22 inches for the smaller varieties, 22 by 22 to 30 by 30 inches for the medium sized, and from 30 by 30 to 48 by 48 inches for the largest varieties, or the distance between the rows may be greater than that between the plants in the row. A favorite distance for Red Spanish is 18 by 22. Smooth Cayennes are often planted 20 by 30 inches apart.

The method of planting in beds about 15 feet wide under sheds has been practiced for a considerable time and is gaining in favor. This allows the laborers to use the shuffle hoe without going between the plants, and also to apply the fertilizer by merely stepping among the plants of the first two rows. It is always necessary to exercise the greatest care in order to avoid breaking the leaves.

On the Keys the laying off of lands is impracticable, but plants must be set wherever there is room and enough soil.

When the planter has determined the size of his lands and the distance between the plants in the row and the distance between the rows, the rows and checks are laid off either by hand or by a horse marker. It is not worth the while to exercise great care to have the rows exactly straight nor the plants placed at mathematical distances, as in twelve months one field will look as well as another. If the soil be somewhat firm the rows may be opened with a small plow. Various other methods are adopted to meet the needs of the individual field.

In planting under sheds the lands, or beds, are laid off so as to leave the roads and ways free from posts, the beds being made as wide as the greatest distance between the posts, with the rows of posts running down the middle of the beds. The location of the roads will depend upon the needs of the individual sheds.

PLANTING.

Suckers are planted for the main crop of the common varieties. Slips and crowns take too long to mature a crop to be utilized excepting when suckers are not to be obtained. Well-matured suckers will produce a crop in fourteen to eighteen months from time of setting out.

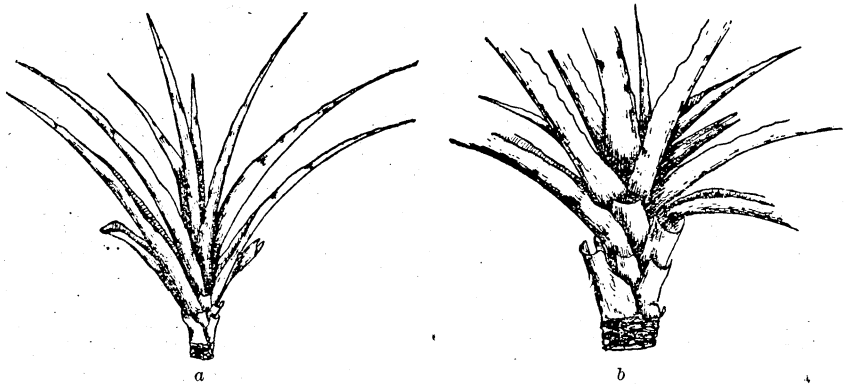
It is desirable to strip off the lower leaves of the suckers and to trim the butt end as shown in fig. 1. Not to strip off these leaves gives a tendency to "tangleroot." After cutting the end off square, the leaves may be stripped off until the newly formed roots are visible. (See illustration *b*, fig. 1.)

The sucker should be set 3 to 5 inches deep, according to size, care being taken not to set it so deep that sand can be easily blown into the bud. Many planters prefer to clip off the ends of the leaves to

keep the wind from blowing the plants over. This is not necessary except in exposed fields and should be avoided if practicable.

Crowns are not utilized extensively for planting because they are shipped with the fruit and it requires a year longer for them than for suckers to come into bearing. In the vicinity of canneries they might be used, but as a rule they are not worth the cost of saving. They are set out just as suckers are, but there is less danger from sanding and from being blown over.

Slips are usually so small that they are used only in the higher-priced varieties, or when plants are scarce. They are treated very much as the sucker, but need much more attention and care. They can not be set more than 2 to 4 inches deep, and even then there is danger of their sanding or being blown over. It usually takes slips a year longer to mature a crop than it does well-matured suckers, though large slips planted at the right time may mature a crop in twenty months.



a *b*

FIG. 1. *a*, pineapple sucker trimmed ready to set; *b*, base of a properly trimmed sucker. (After H. J. Webber, Y. B. U. S. Dept. Agr., 1895, p. 279. Fig. 65.)

Seed is used only for experimental purposes, like originating new varieties. It is said to take these ten or twelve years to mature a crop.

Time of planting.—Plants may be set out at any time during the year, but the favorite time is during the fall after the suckers have made a good growth and are somewhat hardened off. If set at this time of the year they will make considerable growth during the fall months and early winter. If set at the beginning of winter a considerable per cent may be lost from various causes.

If there should be suckers fit to set out during the spring the pineapple grower should not permit any avoidable disturbance at that time, because it is the time of fruiting, when the plants need every advantage possible to produce the finest fruit. Practically the time for setting out pineapple suckers is limited to the season from July to November, and in a more limited way to the 1st of February.

CULTIVATION.

In the sandy region of south Florida very little attention is directed toward the matter of cultivating after the field has been set out. This is by no means due to indifference or carelessness, but rather to the result of years of experience. Many different types of labor-saving implements have been used and nearly all possible ones have been tried, but under the present condition of labor and profit in the cultivation of this crop there will be very little change in the matter of cultivation, simply because the present methods are the best under the existing conditions.

Cultivation as it is now practiced consists in agitating the surface of the soil to the depth of about an inch with a shuffle hoe three or four times a year. Some planters hoe the pines as often as once a month. The roots of the plants do not penetrate the soil deeply. The soil is made up of so large a per cent of sand that it can not bake or form a hard crust. While the hoeing would conserve the moisture to some extent, it does not have so beneficial an effect as on clay soil.

As there are comparatively few weeds, they can be easily kept in subjection by pulling them up.

On the Keys nothing in the way of cultivation can be practiced. The attention given the crop there is restricted to cutting off such large weeds and woody plants as happen to spring up.

In Porto Rico, Hawaii, and the Philippine Islands a different class of soil is utilized for producing pineapples, and more attention must be given to the cultivation of this crop. In all of these sections pineapple growing is still undeveloped, and consequently the cultivation varied and often indifferent. In Jamaica implements that might be called plows are used as ordinary cultivators. This method should reduce the cost of production to some extent, but cultivation is not the heavy item of expense.

Avoid breaking the leaves.—During the growing season the leaves of the pineapple plant are very easily broken. The peculiar and complicated structure of the pineapple leaf makes it very resistant to drought, but if the epidermis is broken it soon loses moisture to an excessive extent, and damage to the plant results. Whatever implements are used or whatever operations are performed in the field, special care must be exercised to avoid breaking leaves.

IRRIGATION.

Whether irrigation is profitable or not must be determined on each plantation and by each individual grower. Where the rains are well distributed and abundant there may not be sufficient advantage from the application of water during a short drought to compensate for the cost of an irrigating plant. Where the grower has gone to the expense

of erecting sheds it will doubtless pay to have a supply of water also. Irrigating plants provided with spray nozzle and standpipes have been used, but it is doubtful if this extra expense is compensated for. The direct application of the water to the soil will doubtless prove just as efficacious.

In the pineapple district of Florida droughts are liable to occur between the time of blooming and ripening. Sometimes they are of a month or six weeks' duration, with a total rainfall of less than an inch. The serious effects of a drought at such a time are very great. These effects are here shown by a concrete illustration: An acre of Red Spanish plants that would produce 4,800 pineapples, 24's, would make a crop of 200 crates and would sell for $650, or at the rate of $3.25 per crate. The same fruit would not do better than to make 30's if a long drought had occurred, and would sell for only $3 per crate, or the whole crop of 160 crates for only $480. Thus, while there would be a shrinkage of only 20 per cent in the number of crates, there would be a shrinkage of over 26 per cent in the returns from the markets.

CANNING.

Canned pineapple has long been known as an article of commerce. Most of the pineapples canned are foreign-raised fruit, being imported fresh or canned abroad and then imported, but mostly the former. In this form pineapples are known in nearly all of the cities and towns in the United States.

For general market.—Large canneries use from 25,000 to 50,000 pineapples per day. This means about 500 crates, or more than a carload a day, to run a canning factory of the size of some in the British West Indies. The peeling and slicing are performed on benches or tables. The men in Nassau canneries receive about 50 cents a day, the women about 25 cents, and the children about 12½ cents. In Porto Rico and Hawaii it may be practicable to establish canning factories for a large output, but in Florida, where labor is scarce at $1 to $1.25 a day during the pineapple season, it can scarcely be considered opportune on an extensive scale at present. Smaller factories that put up other fruit during the year would doubtless be able to take care of a smaller amount of the overripe pineapples.

The process of canning is not complicated, and is practically the same as for other fruit. Of course, experience is necessary to successful work. The fruit is peeled and sliced, put into cans, and the sirup added. The cans are then soldered and immersed in the steam cooking or sterilizing vat. After removal from the vat the cans are perforated to allow the steam to escape, and then the perforation is sealed and the contents allowed to cool. The size of the cans and the concentration of the sirup depend upon the market that is to be sup-

plied. Two conditions—plenty of cheap labor and plenty of cheap pineapples—are necessary to successful pineapple canning.

For home use.—The pineapple is easily canned for home use. The peeling is removed carefully, the fruit quartered or sliced, and the core taken out. The cans, preferably glass jars, are filled with sections and boiling sirup poured on to fill the jars. These are then set into a kettle of boiling water for fifteen or twenty minutes, then they are removed from the kettle, and the cap, which, with the rubber, has been sterilized, screwed on.

Another way is to prepare as before and boil in sirup for fifteen or twenty minutes, then fill into scalded glass jars and put the sterilized rubber and screw-cap on as before. This is more easily done than the former way, but there is more danger of introducing live germs.

For flavoring.—For this purpose the pineapples are secured as fully ripe as practicable. The peeling and slicing is done much as for canning. The sections are then ground and put up in cans or jars of suitable size. Just as little cooking as possible is done when the fruit is intended for flavoring. To avoid sterilizing by means of heat, preservatives of various kinds are used to preserve ground fruit. For the cheaper trade, such as the soda-water fountains in villages, this ground fruit is put up in small tins holding about half a pound. For the larger trade it is put up in larger cans, and for the best trade in glass jars. This method of putting up fruit for flavoring is reprehensible, and even small quantities of the preservative such as may be consumed with each glass of soda water are likely to produce bad effects, especially on children and invalids. Even healthy persons would probably suffer certain injury if small quantities of this preservative were consumed by them daily for any considerable length of time. The fruit to be used for flavoring may also be prepared by treating the ground fruit in the same way as the sliced fruit. This has the disadvantage of losing a part of the flavor, but more of the product may be used and thus avoid the bad effects or the chances of ill effects of the preservative used.

For medicinal purposes.—It is well known that this fruit contains an active principle called "ananasine," which possesses active digestive properties. Advantage has been taken of this fact in the manufacture of pineapple digester and in separating the active principle for medicinal purposes.

TO PREPARE FOR TABLE USE.

While canned pineapple may be used when the fresh fruit can not be obtained, it is only an inferior substitute. To secure the full benefit of this fruit it should be allowed to ripen fully, preferably on the plant. No matter how daintily a pineapple is served it is not quite equal in flavor to the dead-ripe fruit just picked from the plant and eaten out of hand.

Sliced.—With a large knife remove all the peeling, being careful to remove the last bit of the eyes that may remain. Any part of the peel is liable to prove quite acrid. The crown may be used as a part to hold the fruit by, or it may be removed and the fruit held by the use of a carving fork. Beginning at the base of the fruit, slice off whole segments three-quarters of an inch or an inch thick. Sprinkle each segment with sugar to give the desired sweetness. After the entire fruit has been sliced and treated with sugar set aside for twelve hours. At the end of this time considerable pineapple sirup will have formed in the fruit dish and the flavor and palatableness will have been improved greatly, especially if it has been standing in a refrigerator. A good pineapple should be so tender that it can be eaten with an ordinary fruit spoon.

Dug-out.—For this purpose select a large pineapple. Cut the base off square and take the crown out. Then with a thin-bladed, sharp kitchen knife cut around just under the peel, so as to remove the entire meat and leave the peel intact. Cut or shred the meat into suitable shape for use and sprinkle thoroughly with sugar. Set the cylinder made by the peel on a large plate, right end upward. Put the prepared pineapple into this cylinder and place the crown in position until ready to serve. This makes a very pretty ornament on the dinner table, as it looks like a whole pineapple. To serve, the crown is taken off and the prepared pineapple taken out with a fruit ladle or a large fruit fork. Only large fruits can be used in this way, and they must be used soon after being prepared, or else the sugar should be withheld until the fruit is served.

Shredded.—Prepare the fruit in the same way as for slicing and then, by means of a carving fork or other strong fork, begin at the base and pull off the meat from the core. This leaves the fruit in a more palatable condition than when it is cut into small pieces. Treat and serve in the same way as in case of sliced pineapple.

To flavor other fruit.—Some fruits when put up to keep lack character or special flavor. A small amount of pineapple prepared with them imparts a flavor and tartness that is pleasing. This is especially true of oriental pears and quinces.

DISEASES, INSECTS, AND INJURIES.

Under this head are included manifestations of untoward conditions that are usually recognized in the pineapple field, and whose causes are more or less obscure. This includes ravages of insects and insect-like animals, and also those conditions whose agent or cause is at present not known. In studying the literature for diseases of the pineapple one is surprised by the limited number of insects and fungi that attack this species. Saccardo's Sylloge Fungorum records only four species of fungi as attacking species of the genus Ananas, to

which the pineapple belongs. Insect Life appears to mention only one insect that attacks this plant.

The reason for this immunity is not altogether clear. It may be accounted for, in part, at least, by the fact that the plant has but recently been introduced on an extensive scale into field cultivation. To this may be added the fact that the plant is radically different from any other in cultivation, so that insect migration or fungous infection from other crops is greatly reduced. Ordinary insect and fungous pests are not adapted to live on pineapples.

On the whole it is best not to take care of diseased pineapples, but to discard them and start with vigorous plants. It will be more profitable in the end.

BLIGHT; WILTS.

This disease manifests itself by a change in the color of the leaves, beginning at the tips and extending gradually downward. The tips of the leaves wither and dry up. Usually this blight begins with one or a few plants, and gradually the extent of the area is increased.

Cause.—According to Mr. Webber, a root-inhabiting Fusarium-like fungus seems to be the cause of the disease. This would account for the progress of the disease in the individual plant and its gradual spreading from one plant to another adjoining. It seems to attack all varieties of pineapples, but the fancy kinds are attacked the most.

Remedy.—The disease being due to a fungus that lives in the soil, it is impracticable to use the ordinary fungicides for remedial purposes. These, especially Bordeaux mixture, have been used with no apparent beneficial effect. So far as fungicides are concerned they must be considered as of little or no value in connection with this disease of the pineapples.

It has been recommended to take up the affected plants and cut off all the lower portion of the stem until no more black or dark root ends are visible, which seems to indicate that all diseased portions have been cut off; then strip off the leaves as for setting out and reset the plants. This seems to be the only method known that will save diseased plants, and this will not pay for any but the higher-priced varieties.

The usual method of treating a blighted spot is to remove all the plants affected and also some plants beyond those that show blight, then fertilize the spot thoroughly and set out to vigorous suckers. There does not seem to be much danger from this disease holding over if all of the affected plants have been removed. It is well, however, to remove a circle of plants beyond those showing the blight, since some plants in this adjacent area may be infected and not show it. Such a plant would become a new focus for dissemination.

FRUIT MOLD.

Dr. Halsted, of the New Jersey Experiment Station, has found that rotting of pineapple fruits was brought about by a mold known as *Chalara paradoxa* (de Sey.) Sac. While it is not probable that this is the only one of the molds that will cause rotting of the fruit, it is quite probable that the ordinary rots of apple and peaches do not cause rotting in pineapples.

Remedy.—Exercise all reasonable care not to bruise the fruit nor break the peel. Before packing, the fruit should be allowed to become thoroughly dry, especially the broken end of the stem. This usually occurs in the field between the time of breaking and hauling it to the shed.

All refuse fruit should be removed daily from the packing house and its vicinity and the surroundings be kept entirely free from anything of that kind. The refuse pineapples, crowns, leaves, and waste matter generally are propagating places for various molds, the spores of which are liable to be carried to the fruit and wrapped with it ready to induce decay on the first favorable occasion.

MEALY BUGS.

Apparently more than one species of this genus feeds upon the pineapple. These bugs attack the plants at the base of the leaves, usually underground. This insect is so generally distributed in the pineapple section that the full damage it does is not appreciated. At times it becomes so severe that the infested plants show a distinct diseased condition.

Besides attacking the leaves, the fruit is also attacked, especially among the slips and in the eyes.

Remedy.—It is generally supposed that ants distribute the insects and the eggs, but this does not account for their appearance in new fields. As it is probable that they are introduced with the plants, special care should be exercised to secure plants free from this pest. Plants that are suspected as being infested should be discarded or dipped into a spraying solution of resin wash or kerosene emulsion. In the field these remedies have not proved of sufficient effectiveness to warrant their use. Some good can be done, however, in the field by applying a handful of tobacco dust directly in the bud, if this be done before the bloom begins to appear. This destroys some of the mealy bugs and their eggs and it does the plant good in the way of a fertilizer. For preparation of resin wash and kerosene emulsion see Farmers' Bulletin No. 127, by C. L. Marlatt.

RED SPIDER (Stigmæus floridanus Bks.)

This spider mite inhabits the base of the leaves below the green portion. While the pests are present often by the hundreds, they are so

small that the amount of food they take from the plant must be regarded as insignificant. The individual specimen is barely visible to the average unaided eye. The damage is brought about, however, by their opening a way through the epidermis for the entrance of rot fungi. To discover the presence of this mite, pull out one of the outer leaves of a suspected plant and brownish areas will be observed if the mite be present (see fig. 2). After the mite has attacked the plants for some time the leaves rot off at the base, the mites having migrated to fresh leaves, followed in turn by the rot, until all the leaves of the plant have been cut off and the plant practically killed.

Remedy.—The remedy for this is so simple and effective that this pest is no longer a serious enemy. An application of tobacco dust in the bud is usually effective. If one application fails to kill all the red spiders, a second application in two weeks rarely fails to complete the destruction.

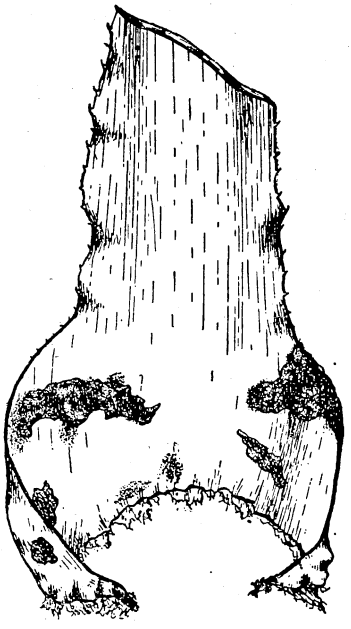


FIG. 2.—Base of a pineapple leaf showing the effect of the red spider's work. (After Webber, Y. B. U. S. Dept. Agr., 1895, p. 282, fig. 67.)

PINEAPPLE SCALE.

This insect (*Diaspis bromeliæ*) is troublesome in the drier districts, but rarely does much damage in Florida. It has been found repeatedly on plants imported from Hawaii, and has been disseminated to many parts of Florida, but has not become troublesome excepting in a few places and in some greenhouses.

Remedy.—Dip plants as for mealy bug or, if present in the field, spray with resin wash or kerosene emulsion, using only so much as is necessary to cover the insects. (See mealy bug, p. 39.)

SPIKE; LONGLEAF.

These terms are applied to a peculiar growth of the plant, in which the leaves grow long and narrow and the edges are inclined to roll in. In severe cases the leaves stand nearly erect and remain so much rolled up that the new leaves have no chance to unfold. In addition the leaves are apt to be rigid. The roots are few, but appear to be normal.

Plants badly affected with spike do not grow out of it. They rarely produce any fruit, and that not of a marketable quality. The disease is transmitted to the suckers or other plants produced by spiky parents. In severe cases no reproduction occurs, but the plant lingers for two or three years and then dies.

Cause.—No organism seems to be connected with this disease. It seems to be due to a peculiar condition of soil or fertilizer. A large percentage of plants set on shell mounds or soil that has much shell in in it are subject to spike. They are also subject to spike if planted over a rotting root or buried stump. Spots in fields where large piles of wood have been burned and the ashes not scattered are also likely to grow spiky plants.

Among the fertilizers which will produce spiky plants are acid phosphate, kainit, sulphate of ammonia, and cotton-seed meal. In fertilizer experiments carried out by the writer and referred to before it was found that nearly all the plants in plots fertilized with combinations of the above-named fertilizers became spiky in less than two years. It is probable that any one of the above-named fertilizers might be used in other combinations and in small quantities without bad effect. Cotton-seed meal has been used for years on certain fields with no bad effects, but such fields were not destitute of other elements necessary for the use of the plants. Sulphate of ammonia has been used in combination with other fertilizers with apparently good effect. Acid phosphate and kainit produced more or less spike in over three-fourths of their combinations.

Remedy.—There is no practical remedy for this condition and the only escape is to avoid it. All spiky plants should be destroyed, so as to prevent any possibility of transplanting any suckers with a spiky tendency.

Avoid planting on shell soil.

If plants show any tendency to become spiky the greatest care should be exercised in the use of fertilizers. A liberal application may be made of bone meal, blood and bone, or dried blood, which seem to be the best forms of ammonia. The potash should be applied with some degree of caution; carbonate and low-grade sulphate are believed to be the best forms. Frequent working with a shuffle hoe seems to be advantageous in a spiky field. Plants showing a tendency to grow spiky should be treated promptly.

SANDING.

Newly set pineapple plants are somewhat slow in beginning to grow, especially if a dry spell follows immediately after they are transplanted. During this time the wind is liable to fill the buds with sand and it seems to have a smothering effect. Subsequent rains beat it in harder and aggravate the matter. If the plants be set a little too deep the sand is liable to wash into the bud and then to form the same kind of a plug.

Remedy.—Sanded plants are difficult to handle successfully. Some pineapple growers have used hand bellows to blow the dry sand out,

and others have washed the sand out by means of a jet from a spray pump. But these are slow and aggravating methods, and it is better to avoid the trouble than to remedy it after it has occurred, although sanding occurs at times in spite of extra vigilance.

To prevent sand from getting into the bud fill the bud with a mixture of cotton-seed meal and tobacco dust. This will form a solid cake and as the new leaves grow out the plug is lifted and no harm done to the plants. As the dews and rains dissolve the plant food it is carried into the soil and the tobacco dust furnishes insecticide as well as plant food. Mix about one part of tobacco dust to four or five parts of cotton-seed meal.

Large suckers planted on the level are in no danger of becoming sanded, but it will pay to make a similar application to them.

RIPLEY SPIKE; GOING BLIND.

Mr. Webber describes this disease as follows: "The diseased slips and suckers, which appear perfectly healthy at first, grow vigorously for a time, but finally throw out one or two rolled-up thickened leaves from the apex, which grow out to considerable length, but retain their thickened and rolled-up character. All growth of the plant now ceases and it suckers from below as if it had fruited. In some plantations this disease of the Ripley Queen affects nearly one-third of the plants and thus it becomes a very serious malady if this variety is to be grown." (Rept. Fla. State Hort. Soc. 1896, p. 894.)

Remedy.—Mr. Webber's experience with the disease leads him to believe that the disease is transmitted and that suckers from "blind" plants produce 63 per cent of diseased plants, while suckers from healthy plants, but from the same plantation, produced only 4 per cent of diseased plants. (Yearbook, U. S. Dept. Agr., 1898, p. 375.) Therefore, avoid planting suckers from plants that have gone "blind."

TANGLEROOT.

This disease will be understood by referring to figure 3. The upper and younger roots have wound tightly around the upper portion of the stem. In the figure the lower leaves have been removed to show this condition. The cause for this peculiar distortion is not well understood.

BLACKHEART.

This disease manifests itself by the heart of the fruit taking on a water-soaked appearance and finally turning dark. The fruit usually becomes worthless before the water-soaked appearance has involved the entire meat.

Cause.—The cause of the disease is not known, though what appears to be the same condition occurs in Queensland, Jamaica, and the United States.

When the disease comes to notice the fruit should be consumed as soon as possible. No attempt should be made to send it to any but the nearest markets. There appears to have been more trouble with blackheart during the winter season and during rainy weather than in the summer and during dry weather.

FIG. 3.—Tangleroot. (After Webber, Y. B., U. S. Dept. Agr., 1895, p. 280, fig. 66.)

PINEAPPLE SHEDS.

As early as 1886 Mr. William Saunders (Report of Department of Agriculture, 1886, page 691) reported the use of a sort of a protection built on posts in the form of an elevated platform and covered with palm (palmetto) leaves to protect pineapples against cold. It was later discovered that the pineapples grown in partial shade were more tender and juicy than those grown in the open. The desire to protect this plant from the winter's cold seems to have been the origin of our present pineapple sheds, though the protecting of pineapples by sheds has now extended to the region where there is little danger of freezing. The value of the half-shade condition in improving the quality of the fruit is now so generally recognized that this is the important consideration by many for building sheds.

This is not surprising when we remember that the pineapple plant does best in those places that have a mean annual temperature of about 75°, with the smallest annual variation, the islands of the tropics being their favorite habitat.

These sheds not only prevent extremes in temperature but also an excessive evaporation; and, as Prof. Milton Whitney has shown, sheds increase the amount of soil moisture during a drought. As this way of growing conserves the soil moisture, it in a way replaces irrigation, but the two go together to produce the finest types of fruit every year.

That land which never suffers from drought is apt to be too wet during a rainy season, and there are very few fields that would not be benefited every year by judicious application of water.

The cost of a shed prohibits its profitable use for the lower grades. Common or small fruits will doubtless continue to be produced steadily in the open field for many years. The average man will consider it a better investment to put out 5 acres in the open than to put out 1 acre under shed, as the two investments are approximately the same. It will be best to continue to produce a large amount of common fruit as cheaply as practicable for the bulk of the market and some fine fruit for those who have the money and the inclination to pay for it.

Cost of shed.—The expense of erecting a shed will vary with the location and the cost of the material and the labor. The maximum cost should not exceed $600 per acre and it seems impracticable to erect

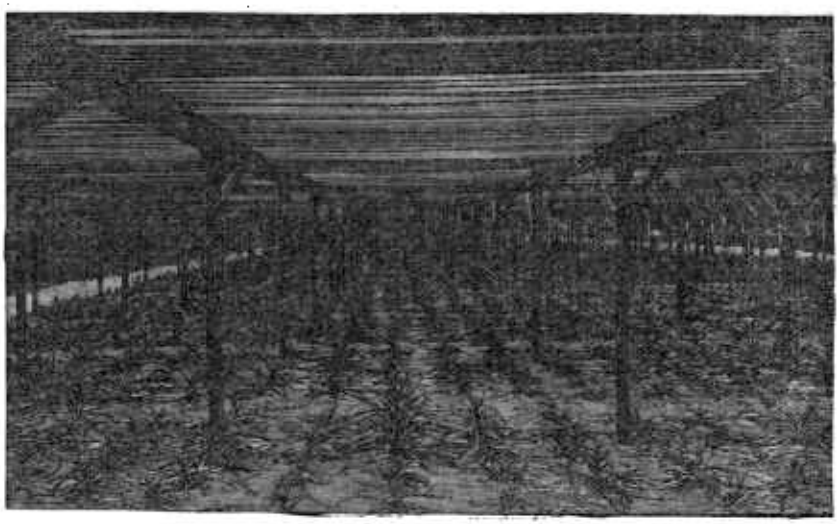


FIG. 4.—Pineapple shed built of boards and planks, showing road at left, ways in foreground running at right angles to road. (After Webber, Y. B., U. S. Dept. Agr., 1895, p. 270, fig. 62).

a substantial shed for less than $325 per acre, even under the most favorable circumstances.

The methods of building the sheds vary about as much as the material at command will permit. All agree, however, in leaving as much space between individual pieces of the covering material as that material is wide, thus allowing one-half of the sun's rays to pass through. This is done merely because this happens to be an easy way of constructing the cover. The cover should not be less than 6½ feet from the ground and it is preferable to have about 7 feet in the clear. If plastering laths are used the cover may be 6 inches lower than when boards are used. (See fig. 4.)

The following statement gives approximately the amount of lumber needed for building a lath-covered shed for about an acre:

398 posts (368 for top, 30 extra for sides) 4 inches by 4 inches by 8 feet.
204 pieces (160 for top, 44 for two sides) 1½ inches by 1½ inches by 20 feet.
900 pieces (840 for top, 60 for two sides) 1½ inches by 1½ inches by 15 feet.
80,000 laths (75,000 for top, 5,000 for sides) ⅜ inch by 1 inch by 4 feet.

The above amounts to about 7,000 feet of lumber, exclusive of the laths. All material must be free from knots and of first grade. The amount of lumber can be still further reduced by using galvanized wire instead of the 1½ inch by 1½ inch by 15 feet pieces, and weaving the laths in this, as in case of building a fence of the same material. It does not seem practicable to make any further reduction in the amount of lumber used and still have a shed that will withstand the elements for a number of years. In the above shed the posts are set 9½ feet by 14 feet apart, and the material covers a trifle over an acre in a square form.

The following bill of lumber will cover an acre in the square form, giving a shed similar to the one illustrated in fig. 4.

463 posts 4 inches by 4 inches by 9 feet.
266 stringers 2 inches by 6 inches by 16 feet.
5,900 boards 1 inch by 3 inches by 16 feet for cover.
450 boards 1 inch by 12 inches by 16 feet for sides.

This gives a total of slightly less than 35,000 feet of lumber. The posts are set 7½ feet by 15 feet apart. If the stringers are to be braced, as indicated in fig. 4, it will take 196 pieces (2 inches by 4 inches by 16 feet) more. The cross stringers (shown in fig. 4) are omitted. The boards used for cover hold the line of posts in place firmly, and by cutting a notch in the top of the post to rest the 2 by 6 inch stringers it will be held in place. So far as the strength of the lumber is concerned, the posts might be set 10 by 20 feet apart, but this distance gives considerable annoyance from the warping of the covering material.

The cost of erecting a shed varies with the type of shed put up and the ability of the superintendent. The labor will cost about $25, and the incidental expenses will be a few dollars for such things as locks, hinges, tools, etc., not including the cost of the nails or wire.

TREES FOR SHADE.

This side of the protection question has not received the earnest attention that it deserves. The writer has seen repeatedly the beneficial effect from the presence of cabbage palmettoes. They not only seem to protect the pineapple plants from the cold of winter, but to be an advantage to the crop in the summer. Hard-wood trees that have a deep taproot frequently grow in the midst of a pineapple plot without

any apparent bad effect and with considerable protecting influence. It is not probable that such conditions would continue indefinitely, since the fertilizer applied to the pineapple plants would sooner or later draw some of the feeding roots of the tree to the surface, and thus divert the fertilizer applied for the use of the pineapple plants. Besides the fertilizer taken from the soil, the trees absorb more or less moisture, which would be of some detriment to the crop during a dry season, at least.

That trees and shrubs have a bad effect upon pineapples under certain conditions can not be denied. Pineapple plants set out alongside of a strip of woods show the bad effect very soon, but this difficulty may be remedied by digging a trench between the native growth and the pineapple plants. This cuts off the feeding roots of the trees and keeps them from taking the plant food and the moisture from the field crop.

Mr. O. F. Cook, in Bulletin No. 25, Division of Botany, United States Department of Agriculture, brings forth very strong arguments for the belief that the good effect produced by planting trees in coffee plantations is to be accounted for by the fact that nitrogen-gathering trees, such as belong to the order Leguminosæ, add fertility to the soil rather than by the direct effect of shade upon the coffee plant. The writer has seen pineapples growing under royal ponciana trees without bad effect upon the pineapple plants. That shade is desirable for the production of the best fruit of pineapples seems to be well established. If in addition such trees as the rain tree, the royal ponciana, etc., can add sufficient nitrogen to the soil, it will greatly reduce the cost of producing the finer grades of this fruit. The building of sheds is the greatest expense, and, aside from plants, the cost of fertilizer the next most important consideration. If, therefore, a shade can be produced by the use of leguminous trees, as the rain tree or the royal ponciana, and they at the same time supply the amount of nitrogen needed, it will greatly reduce the cost of producing the finer varieties of pineapples.

BY-PRODUCTS.

The industry of raising the fruit for market is so remunerative that no earnest attention has been given by the pineapple growers to the use of the by-products.

Some attention has been paid to the preparation of extract for flavoring and for medicinal purposes, but this was not for the purpose of using up a waste product, but for the direct profit of selling the extract. The pineapple digester, mentioned on a former page, is an indication of some of the uses to which the surplus fruit may be put if there should occur an oversupply.

Marmalade.—Small fruits and ill-shaped and defective specimens may be prepared and worked up into marmalades, or what is some-

times called "preserves." For preparing and preserving in this manner see discussion under the head of "Canning."

Pineapple fiber.—The plant after maturing a fruit gives rise to one or more suckers and later in the season dies to become a waste in the field. In this form it is of very little use except that it forms a slight covering as a mulch. During the dry season it may even become a source of danger from accidental fires.

The following quotation in regard to pineapple fiber is taken from Mr. C. R. Dodge's paper in the Report of the Secretary of Agriculture for 1893, page 581:

> Experiments with the fiber were only preliminary, but as far as they went were most satisfactory. The fiber yields readily to machine manipulation and comes out white and clean without washing by simply drying in the sun after being extracted. The desideratum is an economical means of extracting the fiber, and as there are over 20,000 leaves to the ton it will be seen at the outset that the economical machine will be one that takes quite a quantity of leaves at a feeding. The machine used by the Department at Cocoanut Grove was inadequate from the commercial standpoint, as only a few leaves could be extracted at a feeding. It produced almost perfect fiber, however, and enabled us to attain the object of the investigation, viz, the determination of the quality and yield, although without regard to cost.

There are said to be about 60 pounds of fiber in a ton of green leaves—about double the amount in a ton of green ramie stalks. The fiber has many qualities that give it superior merit, and it will doubtless be used some day in the textile industry.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C.:

16. Leguminous Plants. Pp. 24.
19. Superseded by No. 127.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
23. Superseded by No. 142.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
26. Superseded by No. 129.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
29. Souring and Other Changes in Milk. Pp. 23.
30. Grape Diseases on the Pacific Coast. Pp. 15.
31. Alfalfa, or Lucern. Pp. 24.
32. Silos and Silage. Pp. 32.
33. Peach Growing for Market. Pp. 24.
34. Meats: Composition and Cooking. Pp. 29.
35. Potato Culture. Pp. 24.
36. Cotton Seed and Its Products. Pp. 16.
37. Kafir Corn: Culture and Uses. Pp. 12.
38. Spraying for Fruit Diseases. Pp. 12.
39. Onion Culture. Pp. 31.
40. Farm Drainage. Pp. 24.
41. Fowls: Care and Feeding. Pp. 24.
42. Facts About Milk. Pp. 29.
43. Sewage Disposal on the Farm. Pp. 20.
44. Commercial Fertilizers. Pp. 24.
45. Insects Injurious to Stored Grain. Pp. 24.
46. Irrigation in Humid Climates. Pp. 27.
47. Insects Affecting the Cotton Plant. Pp. 32.
48. The Manuring of Cotton. Pp. 16.
49. Sheep Feeding. Pp. 24.
50. Sorghum as a Forage Crop. Pp. 20.
51. Standard Varieties of Chickens. Pp. 48.
52. The Sugar Beet. Pp. 48.
53. How to Grow Mushrooms. Pp. 20.
54. Some Common Birds. Pp. 40.
55. The Dairy Herd. Pp. 24.
56. Experiment Station Work—I. Pp. 31.
57. Butter Making on the Farm. Pp. 16.
58. The Soy Bean as a Forage Crop. Pp. 24.
59. Bee Keeping. Pp. 32.
60. Methods of Curing Tobacco. Pp. 16.
61. Asparagus Culture. Pp. 40.
62. Marketing Farm Produce. Pp. 28.
63. Care of Milk on the Farm. Pp. 40.
64. Ducks and Geese. Pp. 48.
65. Experiment Station Work—II. Pp. 32.
66. Meadows and Pastures. Pp. 28.
67. Forestry for Farmers. Pp. 48.
68. The Black Rot of the Cabbage. Pp. 22.
69. Experiment Station Work—III. Pp. 32.
70. Insect Enemies of the Grape. Pp. 23.
71. Essentials in Beef Production. Pp. 24.
72. Cattle Ranges of the Southwest. Pp. 32.
73. Experiment Station Work—IV. Pp. 32.
74. Milk as Food. Pp. 39.
75. The Grain Smuts. Pp. 20.
76. Tomato Growing. Pp. 30.
77. The Liming of Soils. Pp. 19.
78. Experiment Station Work—V. Pp. 32.
79. Experiment Station Work—VI. Pp. 28.
80. The Peach Twig-borer. Pp. 16.
81. Corn Culture in the South. Pp. 24.
82. The Culture of Tobacco. Pp. 24.
83. Tobacco Soils. Pp. 23.
84. Experiment Station Work—VII. Pp. 32.
85. Fish as Food. Pp. 30.
86. Thirty Poisonous Plants. Pp. 32.
87. Experiment Station Work—VIII. Pp. 32.
88. Alkali Lands. Pp. 23.
89. Cowpeas. Pp. 16.
90. Superseded by No. 135.
91. Potato Diseases and Treatment. Pp. 12.
92. Experiment Station Work—IX. Pp. 30.
93. Sugar as Food. Pp. 27.
94. The Vegetable Garden. Pp. 24.
95. Good Roads for Farmers. Pp. 47.
96. Raising Sheep for Mutton. Pp. 48.
97. Experiment Station Work—X. Pp. 32.
98. Suggestions to Southern Farmers. Pp. 48.
99. Insect Enemies of Shade Trees. Pp. 30.
100. Hog Raising in the South. Pp. 40.
101. Millets. Pp. 28.
102. Southern Forage Plants. Pp. 48.
103. Experiment Station Work—XI. Pp. 32.
104. Notes on Frost. Pp. 24.
105. Experiment Station Work—XII. Pp. 32.
106. Breeds of Dairy Cattle. Pp. 48.
107. Experiment Station Work—XIII. Pp. 32.
108. Saltbushes. Pp. 20.
109. Farmers' Reading Courses. Pp. 20.
110. Rice Culture in the United States. Pp. 28.
111. Farmer's Interest in Good Seed. Pp. 24.
112. Bread and Bread Making. Pp. 39.
113. The Apple and How to Grow It. Pp. 32.
114. Experiment Station Work—XIV. Pp. 28.
115. Hop Culture in California. Pp. 27.
116. Irrigation in Fruit Growing. Pp. 48.
117. Sheep, Hogs, and Horses in the Northwest. Pp. 28.
118. Grape Growing in the South. Pp. 32.
119. Experiment Station Work—XV. Pp. 31.
120. Insects Affecting Tobacco. Pp. 32.
121. Beans, Peas, and other Legumes as Food. Pp. 32.
122. Experiment Station Work—XVI. Pp. 32.
123. Red Clover Seed: Information for Purchasers. Pp. 11.
124. Experiment Station Work—XVII. Pp. 32.
125. Protection of Food Products from Injurious Temperatures. Pp. 26.
126. Practical Suggestions for Farm Buildings. Pp. 48.
127. Important Insecticides. Pp. 42.
128. Eggs and Their Uses as Food. Pp. 32.
129. Sweet Potatoes. Pp. 40.
130. The Mexican Cotton Boll Weevil. Pp. 30.
131. Household Test for Detection of Oleomargarine and Renovated Butter. Pp. 11.
132. Insect Enemies of Growing Wheat. Pp. 40.
133. Experiment Station Work—XVIII.
134. Tree Planting in Rural School Grounds.
135. Sorghum Sirup Manufacture.
136. Grape Culture in the North.
137. The Angora Goat.
138. Irrigation in Field and Garden.
139. Emmer: A Grain for the Semiarid Regions. Pp. 16.
140. Pineapple Growing.
141. The Nutritive and Economic Value of Food.

O